

Final Technical Report: Oregon Water Resources National Ground-Water Monitoring Network Cooperative Agreement G17AC00177 (07/01/2017 through 06/30/2019)

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Agency Name: Oregon Water Resources Department

Title: Oregon National Ground-Water Monitoring Network

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Background

The Oregon Water Resources Department (OWRD) manages water supplies in the state of Oregon. The Department monitors groundwater levels throughout the state to evaluate aquifer sustainability, the impacts of groundwater withdrawals on surface water sources, and the availability of groundwater for new proposed uses. Five principal USGS aquifers underlie extensive areas of Oregon (USGS, 2003; Whitehead, 1994): Willamette Lowland basin-fill aquifers, Pacific Northwest basin-fill aquifers, Pacific Northwest basaltic-rock aquifers, Columbia Plateau basin-fill aquifers, and Columbia Plateau basaltic-rock aquifers. Three additional principal aquifers underlie small areas of the state. Snake River Plain basin-fill aquifers and Snake River Plain basaltic-rock aquifers occur in a narrow strip in eastern Oregon, adjacent to Idaho, and Basin and Range basin-fill aquifers occur in southeastern Oregon adjacent to Nevada. A sizable fraction of Oregon is underlain by pre-Miocene rock that hosts low-yield bedrock aquifers. Although these are not defined as a USGS principal aquifer, they represent an important water supply in many areas of the state, especially west of the Cascade Mountains.

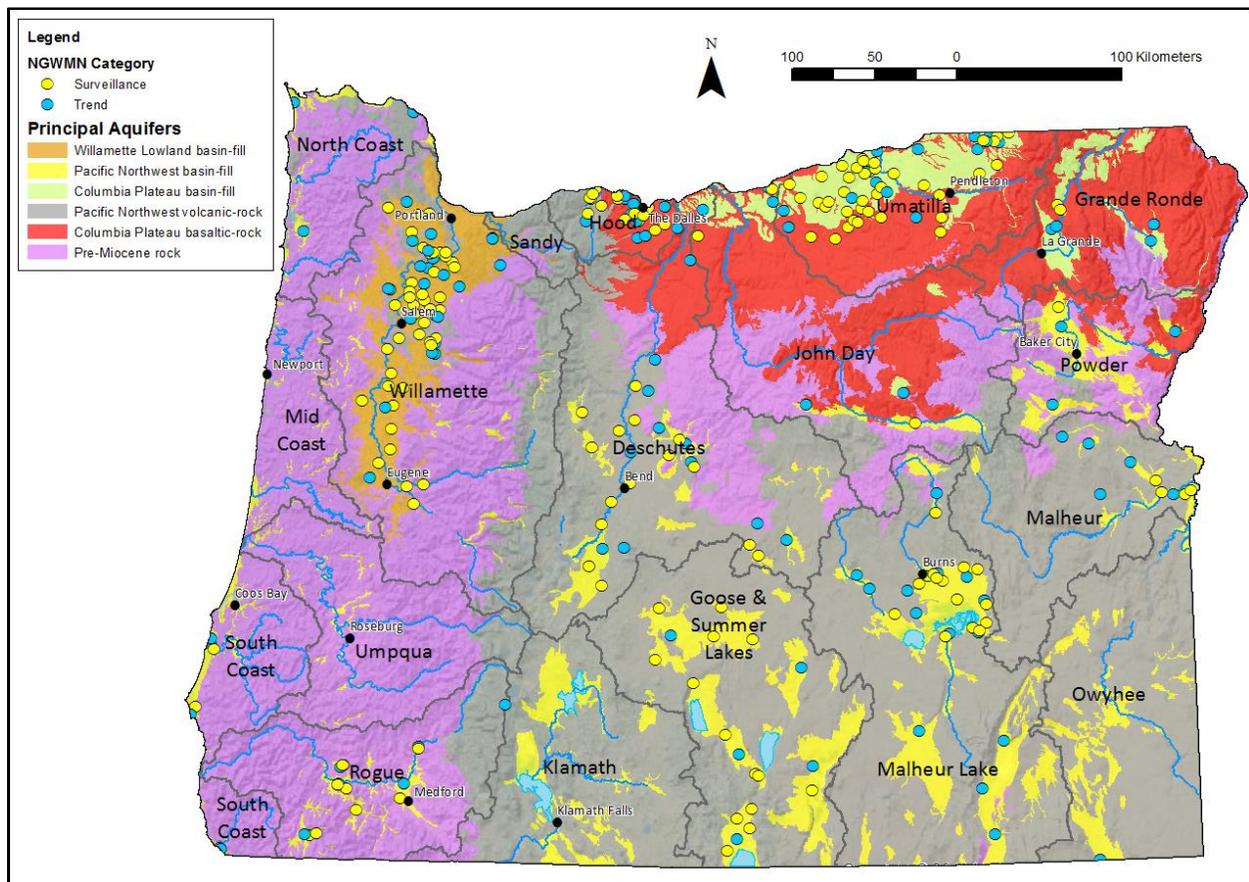


Figure 1. Current OWRD National Groundwater Monitoring Network wells.

OWRD became a new NGWMN provider in 2015 and currently maintains 280 active NGWMN sites that represent five USGS principal aquifers and several locally important pre-Miocene bedrock aquifers (Figure 1). Sixty-seven of the wells have continuous recorders installed.

USGS Principal Aquifer	Trend	Surveillance	Recorder	Total
Columbia Plateau basaltic-rock aquifers	34	46	16	80
Columbia Plateau basin-fill aquifers	5	9	6	14
Other (Pre-Miocene rock)	6	5	5	11
Pacific Northwest basin-fill aquifers	31	39	19	70
Pacific Northwest volcanic-rock aquifers	23	48	14	71
Willamette Lowland basin-fill aquifers	12	22	7	34
Total	111	169	67	280

Description of Work Done to Support the NGWMN Under Award G17AC00177

Award G17AC00177 provided funds to support persistent data services (Year 1 and 2), fill information gaps for existing NGWMN wells (Year 1), and drill a replacement well in the Columbia Plateau basaltic-rock aquifer system (Year 1). The completion of all of all tasks in the award proposal is documented in the following sections under each of the major objectives that were listed in the original proposal.

Support Persistent Data Service

During year 1 of the proposal award period, the Department implemented a major migration of its Groundwater database. The migration included major changes in table structures and data entry procedures and the design of new web-based applications to allow access to the data via the internet. A critical task of the migration was to ensure that underlying changes would not affect OWRD web services that provide persistent data services to the NGWMN. This was accomplished by testing all structural database changes that had the potential to affect web services to ensure continuity of services.

During year 1 and 2 of the award period, OWRD’s Information Services Section performed routine backup, performance tuning, and stored procedure modifications to ensure continuity of web services. In addition, OWRD’s Groundwater Section periodically reviewed and updated metadata for all existing sites in the NGWMN site table.

Fill Information Gaps for Existing NGWMN Sites

All tasks under this objective were completed in year 1 of the award period.

Task 1 in the proposal identified 165 wells as having paper well log records but no corresponding digital records for lithology. Research during the project found that only 151 of these wells had a lithologic record on the associated well logs. These were all entered into OWRD database tables which are now accessible to the NGWMN via OWRD's web services. A placeholder record of No Log was entered for the lithology of the remaining 14 wells. As time and funds become available in the future, OWRD will attempt to conduct down-hole camera surveys or geophysical logs to assess the lithology of these wells.

Task 2 in the proposal identified 258 wells as having paper well log records but no corresponding digital records for well construction. Well construction records were entered into OWRD database tables for all of these wells and are now accessible to the NGWMN via OWRD's web services.

Task 3 identified 63 wells that did not have GPS coordinates. GPS surveys were performed at all 63 of these wells and the new coordinates, horizontal error estimates, and wellhead elevations were entered into the NGWMN site registry.

Task 4 identified 60 wells with historic continuous recorder datasets that were not incorporated into OWRD database tables. Data files were converted to a standard format and processed to subtract barometric pressure, correct for drift, and correct for miscellaneous baseline shifts using a time-series water-information management system developed by the KISTERS Company (WISKI). A standard process was developed for moving the resulting files into SQL tables and calculating daily mean values which are now available to the NGWMN via OWRD's web services. This system is now used to routinely update all of our continuous recorder data. Data from one of the 60 sites, UMAT0003908, were not processed as the transducer had apparently failed shortly after its initial deployment and could not be retrieved or replaced. During the project, 3 additional NGWMN wells with historic recorder data were discovered (DESC0007620, JOSE0055641, UMAT0054639). Historic data from these files were processed in the same manner and are now available to the NGWMN via OWRD's web services.

Drill a Replacement Well

This task was completed in year 1 of the award period.

NGWMN Status	NGWMN Site Nbr	Well Depth (feet)	Principal Aquifer
New Well	UMAT0058119	763	Columbia Plateau basaltic-rock aquifer system
Old Well, still active	UMAT0003958	625	Columbia Plateau basaltic-rock aquifer system

The replacement well was originally proposed as a nest of 3 piezometer wells, each open to a separate water-bearing zone within the Columbia Plateau basaltic-rock aquifer system. An amended proposal, approved by Daryl Pope on March 29, 2018, specified the construction of a single well to monitor the deep regional aquifer. Construction of the new well, UMAT0058119, began on February 6, 2018 and was completed on May 18, 2018 to a total depth of 763. Six-inch casing and a seal were installed to a depth of 700 feet leaving 63 feet of open hole adjacent to the principal water-bearing zone. A standard suite of geophysical logs and a down-hole video survey were run shortly after the completion of the well and a transducer was installed on May 20, 2016 to provide high-frequency water-level measurements. The well has been added to the NGWMN well registry and water levels, lithology, and well construction are now available via OWRD's web services. The Department will continue to monitor the replaced well, UMAT0003958, for several years to establish a record overlap of several years.

In-Kind Data-Collection Activities

During the award period, routine water-level measurements were continued at all active NGWMN sites, and automatic recorders were maintained at 63 sites. All data were routinely entered into OWRD database tables and are now available to the NGWMN via OWRD's web services.

Data-Collection Methods and Quality Assurance Procedures

OWRD collects water-levels and well metadata using procedures and data collection standards that parallel those outlined in the NGWMN Framework document and in Groundwater Technical Procedures of the U.S. Geological Survey (Cunningham and Schalk, 2001). The Department uses steel tapes in a few wells but generally uses commercially available electric tapes from several vendors. Tapes are calibrated annually, or more frequently as needed, using a 500-foot dedicated steel tape that has been calibrated by the USGS Oregon Water Science Center. Calibrated flat tapes (electric tapes with a steel core) are used in all dedicated

observation wells without pumps. Coaxial electric tapes are used in all wells with pumps. In flowing artesian wells, calibrated gages are used to measure shut-in pressure. A few of our NGWMN wells are measured using an airline and a calibrated gage. Whenever possible, independent calibrated electric tape measurements are made to verify airline lengths.

Water-level measurement errors are initially assigned to each measurement based on the tool used to obtain the measurement as follows:

- Calibrated steel tapes 0.01 feet
- Calibrated flat electric tapes 0.01 feet
- Calibrated coaxial electric tapes 0.02 feet
- Uncalibrated coaxial electric tapes 0.10 feet
- Calibrated gage measurements used for shut-in pressures 0.25 feet
- Calibrated gage measurements used for airlines with verified airline lengths 2 feet
- Calibrated gage measurements used for airlines with unverified airline lengths 4 feet

However, these initial error estimates are adjusted upward as needed based on conditions encountered in the field.

Measuring points are documented relative to land surface at each well along with the horizontal and vertical errors associated with the well location and well-head elevation. All field measurements are recorded on dedicated paper forms and archived in a dedicated file for each observation well. Our current database has the ability to capture all metadata now documented on paper forms. Records for each well are reviewed annually to assess the overall quality of the data and to assign a reliability index to individual measurements based on the entire record for the year. When time permits, historical records are reviewed in the same manner.

All current recorder data is processed and reviewed using WISKI, a time-series water-information management system developed by the KISTERS Company. A customized processing file is established in WISKI for each monitoring site based on unique site attributes. Standard protocols are used to subtract barometric pressure (most of our transducers are non-vented models), correct for drift using independent measurements made with calibrated electrical or steel tapes during each site visit, and correct for miscellaneous baseline shifts. Some of these processes are automated by the WISKI software but each file is also reviewed at various times by a hydrogeologist to ensure that the final product meets our quality control standards. The data is also processed to provide a table of mean daily levels. The final, corrected unit measurements and the daily mean values are uploaded into SQL tables, which are then available to the NGWMN Portal via OWRD's web services.

OWRD does not currently have a formal groundwater field-collection manual. However, we are in the process of developing a manual that will outline our standard data collection, processing, and quality control procedures. We anticipate providing this manual to the NGWMN in conjunction with future projects.

Status of OWRD Databases and Web Services

OWRD initially established web services for discrete water levels, mean daily recorder water levels, lithology, and well construction when it became a new data provider in 2015. As noted above, substantial changes were made to OWRD's Groundwater database in Year 1 of the current award. These changes required a number of adjustments to our web services to ensure the continued flow of data to the NGWMN during the performance period. No changes to our database tables or web services are anticipated in the near future.

OWRD web service requests currently available at:

https://apps.wrd.state.or.us/apps/gw/gw_data_usgs/IndexUSGS.html

Documentation of the web services is available at:

https://apps.wrd.state.or.us/apps/gw/gw_data_usgs/IndexUSGS.html#hide1

References

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